CARBON MONOXIDE -- THE ISSUES

CAPT Gary Willis
Shore Safety Programs Directorate
Naval Safety Center
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10/25/98 AG1 failed to answer door in Navy quarters. Victim and 4 children dead from CO poisoning. Wife comatose.

Heater had been scheduled for annual maintenance inspection but was not done. AG1 turned on heat for start of season.

Investigation revealed a number of discrepancies including clogged filters, obstructed air vents and closed make-up air damper.

- There is no federal regulation requiring CO alarms.

- Consumer Product Safety Commission recommends every home have at least one CO detector. At the time of the mishap there was no Navy-wide requirement for CO detectors.

ACCIDENTAL CO POISONINGS FY 94 - 99

Navy Military (On-duty) 15 Injuries 0 Fatalities	Navy Military (Off-duty) 1 Injury 4 Fatalities
MC Military (On-duty) 1 Injury 0 Fatalities	MC Military (Off-duty) 0 Injuries 2 Fatalities
N/MC Civilians (On-duty) 11 Injuries 0 Fatals	NAVFAC Log: 4 Families – symptoms* (*No mishap reports)

• 27 Navy and MC military and DOD civilian personnel were injured in 16 operational CO mishaps

• 4 Sailors and 2 Marines were killed in off-duty poisonings.

- **2 died from bathroom heaters off-base**
- **2 died working on cars in garages**
- **1 died sleeping in running car**
- **1 plus family died in Navy housing**

• 1 Sailor was injured in an off-duty CO exposure

*** Nationally - 500+ deaths per year by CO**

*** U.S. fatality rate for CO = .236 per 100,000 (FY88-96)**

***Navy fatality rate = .0.10 (FY94 - 98)**

NAVY INITIATIVES

- **NAVSAFECEN Msg 301830Z OCT 98**
- **NAVFACHQ Msg 191412Z NOV 98**
- **NAVFACHQ Msg 191801Z MAR 99**
- **NAVFACHQ Msg 061815Z APR 99**
- **CNO 101307Z Msg MAY 99**
- **CNO 201750Z Msg JUL 99**

•NAVSAFECEN Msg 301830ZOCT98 - highlighted the dangers of CO and made recommendations to ensure safety of home.

•NAVFACHQ msg 191412ZNOV98 - directed procurement and installation of detectors in Navy owned or leased housing for all units using carbon-based fuel systems. Also directed inspection of fuel systems.

•NAVFACHQ msg 191801ZMAR99 - alerted commanders to the CPSC voluntary recall of @ 66,000 CO alarms manufactured by Kidde for failure to alarm or alarm late.

•NAVFACHQ msg 061815ZAPR99 - provided guidance for replacement of CO detectors in Navy housing with certified alarms (sensors replaced and charcoal filters added.)

•CNO msg 101307ZMAY99 - outlined inspection and maintenance procedures to ensure quality control procedures in place for proper functioning of fuel burning systems.

•CNO msg 201750ZJUL99 - reported less than 40% completion of alarm replacement and requested expedition of completion of installation.

•(NAVFAC advises 41,816 reworked alarms received as of 8/17/99; 23,220 installed - @ 56% of original purchase)

CO TECHNOLOGY TODAY

FEATURES

- **Digital display of peak CO plus current levels of CO**
- **Battery backup for plug-in units for power failures**
- **Portable units - Lithium batteries - 5 yr life - ideal for OCONUS since availability of 220 volt units limited & power sources unreliable**
- **Interconnectable units for bedrooms, garage, utility room, apartments**
- **Central monitoring of homes at remote site such as security co.**
- **Combination CO/Clock Radios**
- **Personal Clip-on's @ 1.7"x4"**
- **Color change**

Sensor Technology

Colorimetic Sensor - Mimics body's response to Co - chemically treated gel changes color with CO - light senses color changes & signals alarm - household gases can darken gel

Tin Oxide Sensor -Senses changes in electrical properties of metal oxide semi conductors; requires 110V; sensitive to low household humidity in very cold climates below zero degrees

Electrochemical (Fuel Cell) Sensor - Works like a battery creating own current; CO changes electrical properties of fluid in cell; state of art - filters can correct interference gases

- **Colorimetric (biomimetic) sensor - least reliable of the three; interference gases include common household cleaning products & odorant gas in natural gas appliances**

- **Tin oxide sensor - do not work in extremely cold conditions (20 below zero) where activity in house is low (no showers, cooking etc.). Units do not work with battery alone.**

- **Electrochemical sensor - best of 3. These and tin oxide sensors use computer chip to track exposures over time, signaling alarm when certain level of CO is reached. Interference gases are a problem as in Kidde recall. Filters are fix.**

UL STANDARD 2034

PERFORMANCE - UL 2034 Standard, 1998 - CO Detectors for Residential/Marine. Requires units to alarm within 90 minutes at a max CO level of 100 PPM, within 35 mins at 200 PPM , and 15 mins at 400 PPM.

• Alarm must sound before adults experience symptoms.
• At 400 PPM headache and nausea is experienced after 1 - 2 hrs.
• Death occurs at 800 PPM in approx 2 hrs.

RELIABILITY -
- **Sensors required to operate correctly in presence of 5 gases.**
- **UL proposing addition of 6 or more gases including ethanol.**
- **UL proposing companies recall detectors after 2 or 3 years use and determine if failures exceed a maximum allowance.**

1998 UL Standard reduces false alarms by getting rid of nuisance alarms.

Requires companies to signal alarms at levels long before danger for occupants of building occurs, giving time to react to emergency.

Reliability to be enhanced by requirement to not alarm to larger range of gas exposures and by evaluation of units called-back from consumers to identify failure problems, allowing correction in future models.

New Technology

COMBINATION CO/SMOKE ALARMS

•VOICE WARNING TO DISCRIMINATE CO/SMOKE

•COMBINATION CO/CO2/SMOKE/REL.HUM./TEMP

•AUTOMATIC NICAD BATTERY RECHARGING

•RF TRANSMITTER

•INFRARED SENSOR

•IMPROVED SELF-DIAGNOSTICS/AFFORDABILITY

•Combination CO/Smoke Alarms - combines sensors to detect both hazards - difficulty telling what alarm signaling

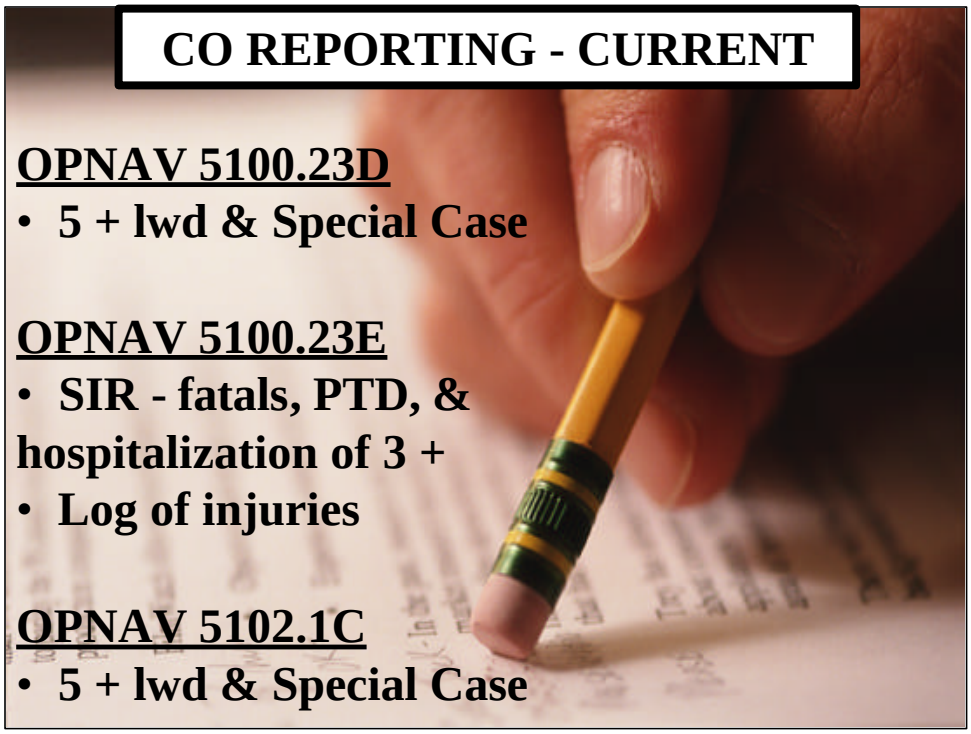
•Voice Warning - eliminates the guess work in identifying type of alarm in combination units. Announces smoke or CO presence.

•Combination Air Quality Detectors - will sample and alarm for CO, CO2, smoke, relative humidity and temperature.

•RF Transmitter - features wireless transmission of alarm signals to remote receiver that can be programmed to automatically dial the fire department or other monitoring facility. Can be interconnected to multiple units.

•Infrared - selected wavelengths (@ 1 meter) sense gases for accurate detection; used in complex lab equipment; very costly but will become marketable in near future

•Improved Self-Diagnostics - as microprocessor power increases units will more accurately detect within desired parameters, eliminating false alarms & improving reliability at less cost



OPNAVINST 5100.23D -

- **Requires reporting of all occupational injuries/illnesses resulting in 5 or more lost work days and fatalities/permanent total disabilities (PTD).**
- **Also requires Special Case reports for people who are not Navy military or civilian employees or other DOD assigned people injured by operational mishaps (includes civilians hurt at air shows etc).**

OPNAVINST 5100.23E -

- **Requires Safety Investigation Report (SIR) for all fatalities, permanent total disabilities (PTD), & hospitalization of 3 or more people hurt in occupational or operational mishap. Also requires SIR for Special Category accidents such as weight handling equipment, confined space mishaps, laser exposures, etc.**
- **Also requires a Log for other occupational injuries and illnesses resulting in first aid or greater treatment.**

OPNAVINST 5102.1C -

Requires reporting of all off-duty injuries resulting in 5 or more lost work days and deaths.

Also requires Special Case reports for people not otherwise reportable hurt because of negligence of Navy operations such as MWR pools etc.

CO REPORTING - PROPOSED

ALL INJURIES REQUIRING FIRST AID/MEDICAL TREATMENT

- **OPNAVINST 5102.1C (Ashore) & 5100.19C (Afloat) - report all off-duty CO exposures using PID report**

- **OPNAVINST 5100.23E - report all occupational CO exposures using SIR**

OPNAVINST 5102.1C and OPNAVINST 5100.19C - very little impact on reporting; change of 5 or more lost work days to first aid treatment - most data elements already in place; same PID report will be used.

OPNAVINST 5100.23E - will require first aid exposures to CO to be reported using same format as Safety Investigation Report (SIR) used for Class A and B mishaps & special interest items such as crane and laser mishaps. Mishap Report Log cannot be used for CO mishaps.

AVAILABLE CO DATA

- **Name of victim**
- **Age**
- **Service status (military, civilian, dependent)**
- **Date/Time of incident**
- **Lost work days**
- **Days hospitalized**
- **Medical diagnosis codes**
- **Percent of CO in blood - carboxyhemoglobin (COHb) saturation**
- **Type of equipment causing emissions (furnace, dryer, range etc.)**
- **Was a CO alarm present?**
  - **Did detector alarm properly?**
  - **Name of alarm manufacturer**

**** NAVSAFECEN can provide recurring reports***

The following NAVFAC requested elements <u>cannot</u> <u>be added</u> to existing coding field without extensive programming (1 - 2 years estimate):

- **Measured level of CO in the space where exposure occurred**
- **Whether or not equipment producing emissions was previously red-tagged**
- **Model of CO detector**
- **Serial number of detector**
- **Location where detector was installed**
- **Whether or not detector was on a maintenance schedule**
- **Who responded: Fire department or rescue squad**

WHAT'S NEEDED?

<u>NAVSAFECEN:</u> ALSAFE detailing changes in reporting requirements for OPNAVINST 5102.1C (Ashore) & 5100. 19C (Afloat)

• Navy-wide awareness through Safety Center publications.

<u>OP-45:</u> Change to OPNAVINST 5100.23E, Chapter 14 to add CO mishaps as SIR special interest item

<u>SAFECEN EFFORTS</u>:

OPNAVINST 5102.1C, Chapter 3 (Personnel Injury/Death Reporting) and Appendix A (PID/MPD Mishap Report - Symbol OPNAV 5102-1)

OPNAVINST 5100.19C, Chapter A6 and Appendix A6-H (Off-Duty Recreation, Athletics and Home Safety Mishap Report - Symbol OPNAV 5102-10)

<u>CHANGE</u> :

Reporting criteria from 5 or more lost work days to first aid treatment of CO

Subject Line of Appendix A and Appendix A6H: add words stating "THIS IS A CO INCIDENT" for cases of CO exposure resulting in first aid or greater treatment

Values for "LOCATION WHERE MISHAP OCCURRED" to include bedroom, kitchen, bathroom, garage

Scope of question "IF PERSONNEL ERROR, STATE CONTRIBUTING CAUSES" to include percentage of CO in blood (COHb) expressed as decimal.

Question concerning "PERSONAL PROTECTIVE EQUIPMENT/CLOTHING" to include CO alarms. Indicate if a CO alarm was available, used, effective, or failed/misused. Also the identity of the manufacturer and name of the alarm .

Narrative to include identification of type of equipment causing emissions such as gas powered furnace, heater, dryer, logs, range, and tools as well as vehicle and generator exhaust.

<u>OP-45 EFFORTS</u>: Change to SIR special interest item reporting requirements of OPNAVINST 5100.23E, Chapter 14 to include CO exposures resulting in first aid or greater treatment

Questions?